No. 78 January 1998

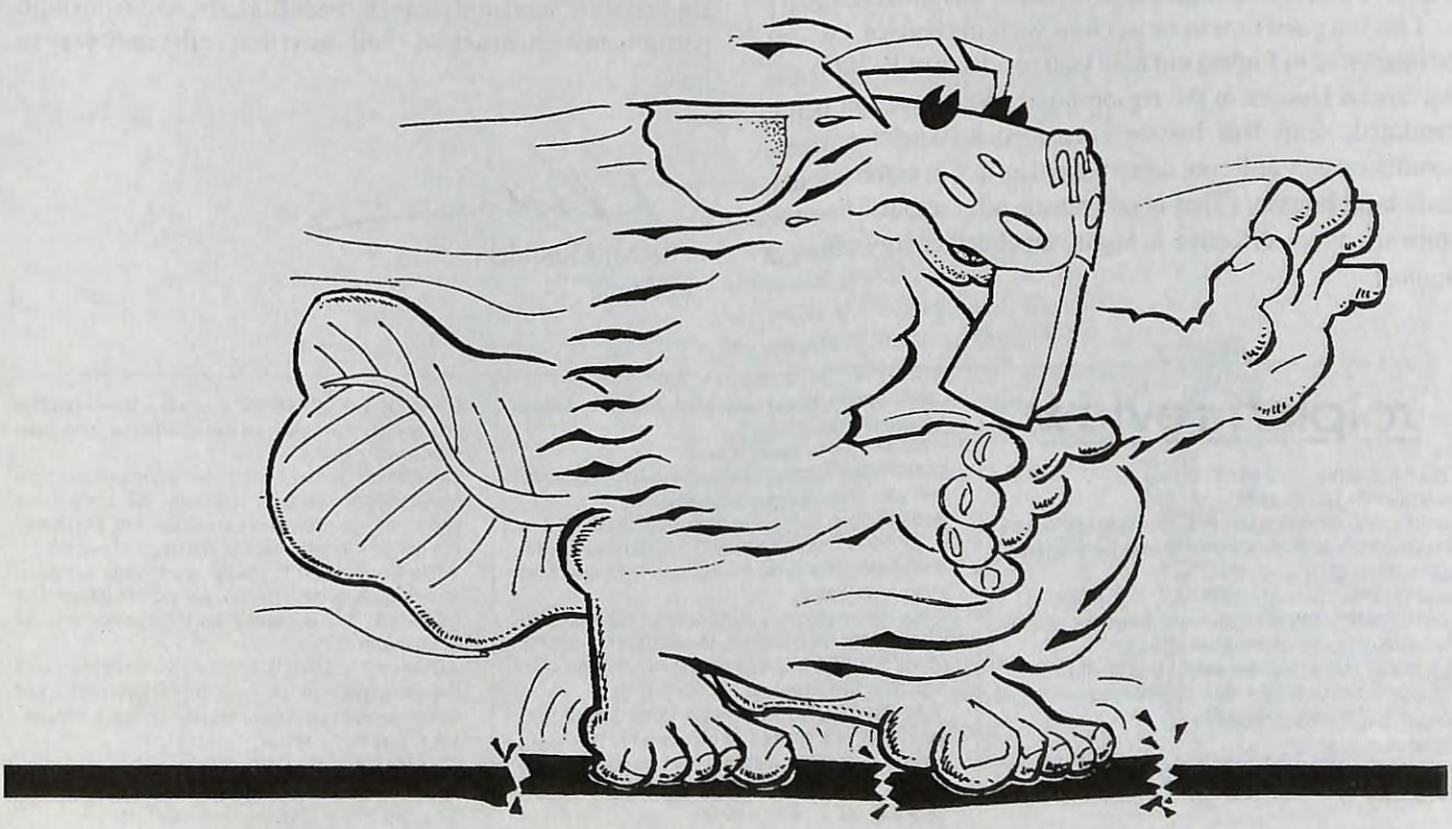
solplan review

the independent journal of energy conservation, building science & construction practice

Contents . . .

Building for Wind and Earthquakes 3
Window Technology Upgrades 5
Integrated Heating (Combo) Systems and Bacterial Growth 7
You Asked Us: About Product Approvals and Certification 8
How Much Electricity Do We Really Need? 9
Pollutant Source Strength in New Houses: Comparing Conventional and R-2000 Houses ... 10
Technical Research Committee News 12
Dynamic Performance of Floors, IRC celebrates 50th anniversary, Code Review Task Force
Letters to the Editor 13
Renovation/Addition, North York, Ontario 15
Design Alternatives 16
Energy Answers: What is a safe level of CO in a house? 17
Power Consumption in the Off Position 18

Building for Wind & Earthquakes



From the Editor . . .

This winter's ice storms in Eastern Canada underline our reliance on technology for survival where we live. For weeks, millions of people were without electricity. The images that we on the West Coast saw were of thousands of people huddled in public shelters. Others huddled around their open fireplaces, which as we know, are one of the most primitive and inefficient heat sources ever devised by man. Not only are they inefficient (although if that's all you've got, it's obviously better than nothing), but the way most fireplaces are built, they can't take prolonged high operating temperatures.

Little worked in areas affected by the storm. When you think about it, there are precious few things we use today that don't rely on electricity - even non-electric energy systems need it to run controls, fans, etc. The only source of heat people had was anything that did not rely on electricity, such as wood and manual gas stoves.

Then there were the carbon monoxide poisonings, as frantic people brought barbeques and camping stoves inside to cook on and provide heat (and pollutants). Even regular fireplaces were contributing pollutants, especially CO levels - proving once again that unvented open combustion indoors is, to put it simply, nuts. (Yet gas heater manufacturers in the US have convinced most states to allow unvented heaters!)

This is a good time to reflect how we build houses. I would be interested in finding out how well residents of R-2000 and Advanced Houses in the region fared. We know that better insulated, draft free houses keep heat in. Under extreme conditions they still cool down but not as fast as conventional, code built houses. (That is one reason why setback thermostats are not as effective in highly insulated energy efficient homes).

If more homes were built to at least R-2000 standards, more homes would have maintained somewhat tolerable conditions for the duration of the power outage. I'm not implying that all would be toasty warm, but I suspect that the pain and suffering would not have been as severe as for those in older, conventional, drafty, under-insulated houses.

The argument usually raised by those who question the establishment of energy performance standards is that the "marketplace" should decide the appropriate energy levels. If people don't want to upgrade insulation it's because they want short paybacks.

I wonder how many people in Eastern Ontario or Quebec were saying to themselves "I'm glad I didn't let my builder talk me into spending an extra $ 2,500 to go to R-2000 or Advanced House standards because that's overkill. It's just not cost effective. The food we lost, the inconvenience and agony just weren't worth the extra little bit for more insulation, better windows and draft proofing when we built. This three-week power outage is just a freak storm and most of the cost is covered by insurance."

I hope that enterprising builders will try to find out how R-2000 home owners fared in the storm, collect testimonials, and shout loud and clear the benefits to be had from high performance construction - and insist that is the only way to build.

Richard Kadulski,
Editor

solplan review
the independent journal of energy conservation, building science & construction practice

Editor-Publisher: Richard Kadulski
Illustrations: Terry Lyster
Contributors: John Broniek, Rob Dumont, Mario Kani, Jim Stewart, Peter Piersol, Peter Postma, Dennis Trester
ISSN: 0828-6574
Date of Issue: January 1998
SOLPLAN REVIEW is published 6 times per year by: the drawing-room graphic services ltd.
Box 86627, North Vancouver, B.C. V7L 4L2
Tel: 604-689-1841 Fax: 604-689-1841
e-mail: solplan@direct.ca
Street address:
208-1280 Seymour St.
Vancouver, B.C. V6B 3N9

Canadian Publications Mail Product Sales Agreement No. 454532
Postage paid in Vancouver, B.C.
COPYRIGHT 1998 by The Drawing-Room Graphic Services Ltd. All rights reserved.
Reproduction without written permission of the publisher is strictly forbidden. Transgressors who don't take heed note: the sudden thaw will bring more than water.
A license for photocoyping or other reprographic coyping can be also be obtained from CANCOPY (Canadian Copyright Licensing Agency, #900 - 6 Adelaide St E, Toronto ON M5C 1H6).
SUBSCRIPTIONS: In Canada 1 year $40.66 (incl GST) (NB, NS, NF $43.37 includes HST); 2 years $77.04 (incl GST) (NB, NS, NF $82.80 includes HST). USA and other foreign payable in US $ 1 year $46.00, 2 years $88.00.

CHANGE OF ADDRESS: include a mailing label or copy all information off label for faster, accurate processing.
CONTRIBUTIONS: Unsolicited contributions and manuscripts welcome. Include self-addressed pre-stamped mailer if return requested. Publisher not responsible for loss or damage of same.
While every effort is made to provide accurate and complete information, we do not warrant or guarantee the accuracy and completeness of such information.
ADVERTISING POLICY: Publisher's discretion in the acceptance of any advertisement. No endorsement is stated or implied by the publisher.
PRINTED IN CANADA
GST Registration: R105208805
SOLPLAN is a registered trademark of the Drawing-Room Graphic Services Ltd.

Building for Wind and Earthquakes

In areas subject to hurricanes and earthquakes, builders and designers face the challenge of creating structures that can withstand high wind and seismic forces. Wood frame construction makes it easy to construct strong, durable buildings that meet code requirements and assure good performance in severe weather and earthquakes. It is essential, however, that the structure be properly detailed. While building codes specify the design requirements necessary for all types of construction, many of the prescriptive recommendations are either misunderstood or incomplete.

The earthquake potential of some areas is a given. Fortunately, even in seismically active areas, we do not experience a lot of earthquakes. However, severe wind storms happen regularly. The climate changes that are happening now mean that extreme storms with high winds are going to be seen more frequently in areas that have not experienced them in the past. Even peak wind gusts experienced today can impose severe stresses on portions of a structure. Corners of buildings and roof sections are key areas subject to the largest forces, both positive and negative.

Designs for earthquakes and high winds share some common approaches because both generate similar forces. To build a safe and long-lasting structure it is essential to understand the forces associated with high wind and earthquake zones. Also, it is important to adopt the appropriate concepts, recommended fasteners and construction techniques.

A review of the forces acting on the structure will help our understanding of the key issues.

The structure must be designed for forces acting along both the length and the width of the structure. An earthquake or wind force can act in any direction. In addition to these two lateral forces, wind and earthquakes both create uplift forces. This means three forces, all at 90 degrees to each other, act on every element and every connection. The flexibility of wood framed buildings allows them to absorb and resist these forces.

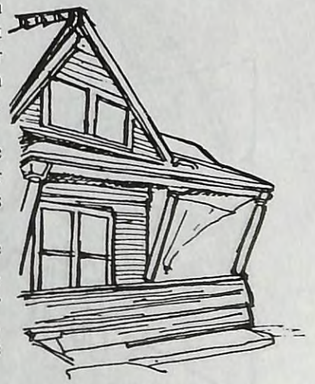
Shear walls and diaphragms are key elements that resist the forces acting on the building. Structural panels such as plywood or oriented strand board (OSB) fastened to the framing create a shear resistant element. These elements can be walls, roof or floor planes. When properly tied together and to the foundation, the shear walls and diaphragm elements give a building a tremendous resistance to lateral forces generally the result of wind or seismic forces acting horizontally on a building or the racking incurred during earthquakes.

For the structural system to work, a well-built roof diaphragm must transfer lateral loads to the shear walls and the shear walls themselves must transfer this load into the foundation. The effectiveness of the system is only as good as the quality and quantity of the connections.

The shear wall elements are often modelled as solid walls. However, the problem is that people want doors and windows in their walls. These openings mean that each shear wall segment has to be designed as an individual small shear wall and the total of all the pieces must have the capacity to carry the total applied loads into the foundation.

In high winds, loss of roofing and roof sheathing is the main cause of structural failure in wood framed buildings. The main reasons for this failure are improper connection details between structural systems and inadequate fastening of sheathing to supporting members. After Hurricane Andrew in Florida a few years ago, damage assessment teams found roof sheathing panels with as few as four fasteners. No wonder the wind tore off the roofs!

Most codes require at least 33 fasteners for a standard 4x8 panel installed over roof supports at 24" o.c. Fasteners, such as 2½" common nails or other code-approved fasteners, should be placed a maximum of 6" o.c. along panel edges and 12" o.c. at intermediate supports.



Important connection points include where the top of a shear wall is fastened to the second floor or roof framing, and where the bottom of the wall is fastened to the sill plate/foundation.

Because fasteners must work against multiple forces, simple toenailing of roof framing to walls, top plates and other supporting elements is inadequate when used without other fastener systems. A toenail only works well when loaded in one

direction, while the forces act in three directions. The same goes for holddown straps which prevent vertical separation but give no protection from the lateral forces of high wind. Fasteners must have sufficient capacity to act in all directions. That means more connections will be needed to ensure adequate strength under all loads.

The most common structural failures noted after an earthquake are buildings that rotate upon or are forced off their foundations. Inadequate fastening and connection details are the culprits. Strong connection of shear walls to the foundation is important.

When an object is bolted down and an earthquake force is applied, an overturning stress develops. The overturning force must be resisted by using connectors called holddown anchors. These connect the framing to the sill plate and thus to the foundation.

Cast-in-place anchor bolts are the most common means of attaching a structure to the foundation. These should be at least ½" diameter bolts spaced no more than six feet apart, with large flat washers to spread the load. The anchor bolts restrain the shear wall segments from the sliding and overturning forces. These forces are not distributed evenly across the structure, but are large concentrated loads at the edges of shear walls. Because these forces have the potential for being very large, nails or even the perimeter anchor bolts are not always enough to deal with the loads. For this reason, holddowns were developed.

A number of manufacturers produce connectors. One of the major players specializing in these is Simpson Strong Tie Co., whose catalogue is available on the Internet at www.strongtie.com.

Another location where framing anchors should be used is at roof truss to top plate connections, where forces in three different directions must be accommodated during high winds or earthquakes. Selecting the appropriate framing anchor simplifies making such connections. ☼

Earthquake Resistant Guide for Upgrading Wood Frame Construction - a CMHC best practice guide is in the final preparation stages, and should be available later this spring.

Much of this article is based on a brochure titled ***Building in High Wind and Seismic Zones****, by APA The Engineered Wood Association. APA also publishes a number of design manuals for engineered wood products. Documents are available in a hard copy or on CD ROM disc. Information:*
APA The Engineered Wood Association
David Birmingham,
Lindsay ON
Tel/fax 705-878-8943
Or APA headquarters:
7011 So. 19th St.
P.O. Box 11700
Tacoma, Washington 98411
Tel: (206) 565-6600
Fax: (206) 565-7265
http://www.apawood.org

Lateral load: forces applied parallel to the ground surface. (Wind, seismic forces, backfill, etc.)

Uplift: forces applied perpendicular to level ground surfaces in an upward direction. (Wind uplift and vertical seismic forces).

Base shear: The reaction at the base of a wall or structure due to an applied lateral load - a sliding force.

Overturning: What happens when a lateral force acts on a wall or structure which cannot slide - "Tip Over Force."

Beam action: Distributes/transfers loads around an opening and into the remainder of the structure - "bending force."

OOPS!

The masthead in the September 1997 issue of Solplan Review included a warning that "reproduction without written permission of the publisher is strictly forbidden, and that transgressors who don't take heed will feel heat that won't be just an Indian summer afterglow." Well, it has been a bit warm here lately!

The lead items in the issue ("Air Sealing" and "How Tight is Too Tight?") were based largely on papers presented at the Affordable Comfort Conference in Chicago, in April 1997 by David Keeve (President of Building Tune-Ups Inc.), a consultant based in Fairfax, VT.

It is not our policy to use material without giving credit. Unfortunately, in the formatting rush to get the issue out, the credit note for the source of the material of these two items was omitted and for this we apologize. Ed.

Window Technology Upgrades

Windows provide natural light and allow us to look out at the views. In the right condition they also provide solar heat gains. We must also recognize that heat losses through windows also can account for up to 50% of the annual energy consumed in a typical house.

Until recently, glass was glass. There was little difference between different products. However, new products developed in the past few years have meant a significant change in the industry. Evolution of glass technology means that windows today are no longer the same product they were a generation ago. Today's high performance products provide greater comfort and reduced heating costs. The insulating value of the best windows available today is almost as good as an insulated 2x4 wall of a few years ago.

It is important to recognize the changes that have taken place. The major changes are the new coatings that selectively filter the sun's rays to reduce summer overheating and winter heat loss. In the summer, these products let in visible sunlight while blocking infrared and ultraviolet solar energy. In winter they reflect room-side heat back into the room.

Windows should now be selected not only for their hardware design and frame profile but also on their glass properties. Performance criteria have to be considered, as they will affect comfort, mechanical system size and aesthetics. The home's design and location must also be considered. During selection, trade-offs or compromises may have to be made as some properties may conflict with each other. The selection process is complicated by some manufacturers who claim performance values that may not be tested to normal industry standards, or test results which are presented in a way that makes it difficult to make fair comparisons.

The most significant new developments are the coatings applied to the glass. The coatings can change the appearance and the performance. Tinted glass with a low solar heat gain has been with us for some time. These are very visible. They mostly absorb and/or reflect the incoming solar energy. New coatings provide a wide range of shading coefficients some with high visible light transmission and up to 70% less UV transmission compared with standard double glazing.

New low-e coatings are often completely transparent, although some may have a slight mirror-like appearance at some times of day when looked at from certain viewpoints. The effectiveness is measured by the emissivity of the glass (how much energy is given off by the material). The lower the number, the more effective the material.

There are two kinds of coatings:

Pyrolytic (hard coat) low-e coatings are applied during the manufacture of the glass. This means the glass can be heat treated after the coating application. It can also be used in single glazingapplications as it has good abrasion resistance. Emissivities for pyrolytic coatings range from 0.20 to 0.40. Some manufacturing processes are subject to a surface haze, and there is a potential colour difference from different batches of glass.

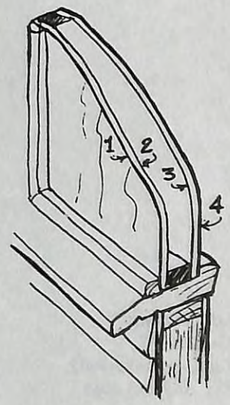
Sputtered (soft-coat) low-e coatings are applied by a process that puts coatings onto the surface of finished glass. As the name implies, the coatings are fragile, subject to damage and corrosion, so must be used in a sealed unit (when exposed to air they have a limited shelf life - usually six months). However, the benefits are very high performance and, once sealed in a double glazed unit, the coating has a long life. Generally, soft coat low-e glass has a good optical clarity with little colour or haze.

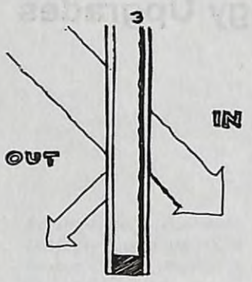
If glass has to be tempered, it must be heat treated before the coating is applied. For the window manufacturer, an extra step has to be taken, as the coating on the edge of the glass has to be removed before the unit is assembled.

How do low-e coatings work?

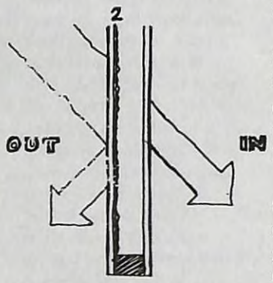
The soft coat low-e is actually a series of microscopic layers. A metallic layer one or two molecules thick is put on the glass, then a silver oxide layer that is covered with a protective coating. Cardinal glass, in their low-E² product, has a five-layer sandwich on the glass.

The coatings are transparent to short wave radiation, but opaque to long wave infrared energy. So not only is the quality of the coating important, but also its location. In a heating climate, where keeping the heat inside is most important, the coating should be on the outside face of the interior





Low-e on surface 3 allows solar energy to enter, and keeps heat in.



Low-e coating on surface 2 restricts solar energy entering into building, keeping more heat out.

glass (surface #3 when looked from outside) of a double glazed window unit.

In a cooling climate, where the situation is reversed and you want to keep the heat out more than in, the coating should be put on surface #2 (the inside of the outer glass layer). This may seem like a subtle distinction, but is important to make, especially as some window suppliers that sell to the southern United States may try for convenience to offer a "one size fits all" approach.

Cardinal glass has developed a very low emissivity soft coat product marketed as low-e², which has impressive performance characteristics. In southern cooling climates these windows can have a significant impact on mechanical system requirements and house performance with the coating on surface #2.

In northern heating climates, although the performance is impressive, there is a winter penalty for this design. Unfortunately, perhaps because of convenience, Cardinal is pushing the low-e² with the coating on surface #2, dismissing winter solar heat gain benefits.

Cardinal's marketing material even emphasizes how little sun there is in the winter in northern locations, downplaying any passive solar gains. By implication, they are saying, "forget any solar heat gain potential". Their strategy generally ignores the way Canadian houses are built today. A draft free, energy efficient house will make good use of even the limited solar potential in winter. We have evidence that even in cloudy northern locations a well insulated house, with high performance windows, can have up to 50% of reduced space heating needs supplied by solar gains.

On orientations, other than the south side, keeping the heat in is very important. Houses are also more comfortable in the summer - before mechanical cooling is introduced. These passive building design strategies may sometimes even eliminate the need for mechanical cooling.

Are the new glazing types really that significant? I recently reviewed plans for a substantial new house to be built in the Vancouver area. The house will be situated on a west facing waterfront property with magnificent panoramic views from north to south, with most glass facing west. Because of the spectacular site, the architect designed a house that has more glass than wall area - most glass being wall to wall and floor to ceiling, with a big skylight running the length of the house. For west facing elevations horizontal overhangs just do not work.

The contractor was concerned about comfort conditions and cooling loads, which can be substantial with the western waterfront exposure. Calculations revealed that by changing regular double glazed low-e windows to high performance, low solar heat gain coefficient glazing (Heat Mirror™ 66) the home's cooling load would be reduced from 16 tons to less than 10 tons, and the space heating load would decrease by more than 60%. The extra cost for the glass could be offset by a smaller mechanical system. The payback (due to operating cost savings) could be something less than 5 years. ☼

Glazing Terminology

Emissivity: the measure of a surface's ability to emit long-wave infrared radiation (room temperature radiant heat energy). Emissivity varies from 0 (no emitted infrared) to 1 (100% emitted infrared). The lower the emissivity, the lower the U-value (or the higher the R-Value). Clean aluminum foil has an emissivity of 0.09, while regular glass, gypsum, and wood is 0.9.

U-Value: the amount of heat transmitted by the window. The lower the number, the more efficient the window is in reducing winter heating loads and costs. Expressed in BTU/hr/ft²/°F.

R-Value designates a window's resistance to heat flow. This number is the inverse of the U-Value; the higher the number, the better the insulation value.

Solar Heat Gain Coefficient: the fraction of incident solar radiation entering a home through the windows. The lower the number, the better the window is at preventing solar gain - critical to reducing summer cooling costs but bad for maximizing passive solar gains.

Shading Coefficient: the ratio of solar heat gain through a window to the solar heat gain through a single lite of 3mm clear glass under the same set of conditions. The coefficient can vary from 0 to 1. The smaller the number, the better the window stops the entry of solar heat.

Information:
Cardinal IG
Tel: 1-800-689-9002
Fax. 360-956-9069

Integrated Heating Systems and Bacterial Growth

A big fear for regulators when any new technology is being introduced is that it will affect health. Anything that could contribute to growth of toxic bacteria naturally raises alarm. The increased use of integrated (combo) heating and hot water mechanical systems have raised concerns that conditions would be right to allow for the growth of *Legionella pneumophila* bacteria.

The Legionella bacteria are present in the natural environment and have colonized plumbing systems and cooling towers throughout the world. Forty species have been identified in the family of Legionella. One of these species has 15 subgroups known as *legionella pneumophila* and only one of these has 5 subgroups that have varying degrees of virulence to humans. Of the people exposed to these 5 subgroups of Legionella, between 2 - 5% actually contact the disease. The most susceptible include the elderly and those with suppressed immune systems, heavy smokers, and alcoholics.

Supply water pipes provide an avenue for bacteria to move through the plumbing system. As a result, people often ingest (through eating or drinking) Legionella bacteria, but this does not cause the disease. The disease can only happen when contaminated water has a high enough bacterial concentration, is aerosolized into a mist, and the mist is inhaled into lungs by the susceptible individual.

A survey of potable water in 12 cities across Canada found Legionella present only in cold water taps or showers. Although hot water samples (45.5°C [114°F] or greater) were taken from all buildings, none contained detectable quantities of Legionella. In Quebec City, 11 of 37 electric water heaters were contaminated with Legionella, but none of the 17 oil or gas models in the same area were contaminated.

Part of this can be explained by the design of the heaters themselves. In fossil fuel fired heaters, the heat source is at the bottom of the tank. During the heating cycle, when the flame is on, the water immediately adjacent to the heater may be subject to high temperatures. In electric heaters, the heat source is typically two elements immersed in the tank, the lower being near but not at the bottom, so that there may well be a pocket of cooler stagnant water that could allow the bacteria to grow.

Scientific literature shows that Legionella will not survive or grow in gas-fired (fossil fuel) water heaters if the water temperature in the tank is maintained at 60°C (140°F). As a result, Legionella growth should not be present in the fan coil and piping of a non-functioning space heater during the warm periods of the year when the space heater is not is use if the water heater is always maintained at this temperature.

Research shows that when the design and selection criteria identified in the Unified Canadian Guideline for Integrated Heating Systems is followed, the risk of Legionella infecting the potable water system in a residential building is negligible. The Guidelines for Combo Heating Systems criteria address the concerns regarding the possible compromise of public health and safety relating to bacterial infection.

The criteria for 140°F (60°C) hot water from the water heater meets or exceeds the recommendations from the research findings. There is no research evidence of Legionella pneumophila colonizing fossil-fuel water heaters or combo heating systems. If bacterial growth did occur during the non-heating season, the bacteria would be destroyed by exposure to 140°F (60°C) water in the heater, once the heating season begins. ☼

Copies of ***Unified Canadian Guideline for Integrated (Combo) Heating Systems*** *are available from*
HRAI, 5045 Orbitor Drive
Building 11, Suite #300
Mississauga, Ontario
L4W 4Y4
Tel: 1-800-267-2231
Fax: (905) 602-1197

design & consulting
energy efficient building
consulting services
R-2000 File Manager
HOT-2000 analysis

Richard Kadulski Architect

#208 - 1280 Seymour St.
Vancouver, B.C. V6B 3N9
Tel: (604) 689-1841
Fax: (604) 689-1841

e-mail: kadulski@direct.ca

You Asked Us:
About Product Approvals and Certification

I want to use loose fill cellulose wall insulation, but the BC Building Code does not explicitly state that it is an acceptable material. I really want to use the product as I'm convinced it is the best one to use but my building inspector does not want to approve the use of the product. What can I do to convince the local inspector?

In BC there is no province-wide product approval system. The BC Building Code leaves the final decision and implied responsibility with the local building official. Unfortunately, local officials do not always have the ability or resources to evaluate equivalents, so they have to rely on professional evaluations.

You have the option of using only those products explicitly covered by code regulations, or tested by accredited organizations to standards identified in the code. This is the preferred option for your inspector. Another option is to have a professional certify that the product meets the code requirement under the equivalency provisions. Having a professional issue the certification provides the documentation the building official needs to satisfy himself that all due diligence has been done, and a responsible party has taken responsibility for the product. Obviously, this option is the least preferred, due to the aggravation, time and expense involved.

Your case points out a significant issue that our industry will have to deal with as we move toward objective-based codes, and that is the administration and interpretation of code requirements. Although a text similar to today's code document will exist as an example of "good practice," the basic code document will eliminate all prescriptive requirements and leave more discretion in the interpretation of requirements. This could lead to more reliance on professionals at all stages of construction, even in situations where it should not be necessary. However, this requires the buy-in of all participants in the process. As your case points out, there are always going to be situations where difficulties can arise when there is a disagreement in interpretation.

It is worth reviewing how the Building Code references building products and systems. Many standards cover the manufacture and installation of various building products used today. Several ways are available to prove conformity to those standards, including testing, manufacturers' declarations, evaluation and third party certification.

Certification is the confirmation, by an independent organization, that a product or service meets a given requirement. Generally, certification programs are designed to meet the needs of regulatoryauthorities. However, the code does not require that all products be certified by accredited agencies as your building inspector is asking for. That is only one option.

Many Standards Council of Canada (SCC) accredited agencies were listed in the January 1997 issue of Solplan Review ("Certified Building Products"). One organization that is a special case and does not appear in that list is the Canadian Construction Materials Centre (CCMC). The purpose of CCMC is to complement industry-supported conformity assessment programs offered by other SCC accredited organizations.

CCMC is not an "accredited" organization. If a product is a part of an industry supported certification program, then CCMC refers manufacturers to that body. Where there are no such programs, then CCMC gets involved with product testing and evaluation. CCMC itself is not a testing organization. Any testing required to show compliance to CCMC technical requirements is done by laboratories recognized by CCMC for that particular test. Test results are then examined by a CCMC evaluation officer.

Products and systems evaluated are those whose performance would be difficult, if not impossible, to predict with any degree of certainty without laboratory testing or specialized scientific knowledge. The evaluations are done with respect to their demonstrated compliance with the requirements of the applicable CCMC technical requirements.

The CCMC, a part of the National Research Council's Institute for Research in Construction, provides a national third party technical evaluation service for new and innovative materials, products, systems and services in all types of construction. Established in 1988, CCMC enlarges the scope of the housing products evaluation service previously at Canada Mortgage and Housing Corporation. As part of NRC's Institute for Research in Construction, the Centre has technical support, access to the most up-to-date information on construction technology, and a direct liaison to the Canadian construction regulatory framework, especially codes development and intent.

The CCMC evaluations are a credible source of information for building officials, designers and specification writers, and also a marketing tool for product manufacturers. In Ontario, CCMC is the only organization designated as a materials evaluation body for the purposes of supporting provincial rulings on innovative materials, systems and building designs. CCMC evaluations are also endorsed by other provinces and territories (including BC) as a basis for determining the acceptability of new products within the context of building code requirements, although that is not written into regulations.

By tapping the research expertise available at NRC and its network of experts around the world, CCMC can develop technology-driven assessment requirements for the most unorthodox of new products. After a product has been tested by a recognized laboratory, the manufacturer-supplied test data are evaluated in relation to those requirements. Products that make the grade are given a unique CCMC evaluation number.

CCMC evaluation reports specify how the products are to be used for the evaluation to be valid. They are valid for one year, but can be renewed annually and are re-evaluated every three years. The evaluations are published semi-annually in a paperback book: The Registry of Product Evaluations. Individual evaluation reports are indexed four ways: Masterformat number, manufacturer's name, product name, and report number. All reports are also available on the Internet, and can be downloaded.

The Centre eliminates the duplication of evaluation services across the country, helps new products get established in the marketplace more quickly, provides a valuable reference source for information on new products and systems, and supports companies marketing their products abroad. For instance, if a product for which a CCMC evaluation is sought is of a type that is already the subject of an industry-supported and accredited certification program, the proponent of the product will be referred to the organization offering such a program.

Evaluations for new products or uses for which no standards exist are based on technical guides developed by CCMC based on the latest information. They are often designed to show that the performance is equivalent to that required in a building code such as the National Building Code of Canada. ☼

A subscription to the Registry of Product Evaluations is free. You can also check their website for copies of all product evaluations: http://www.nrc.ca/ccmc

IRC Client Services,
Institute for Research in Construction, National Research Council of Canada,
Ottawa, ON K1A 0R6
tel. (613) 993-1231
fax: (613) 952-7673

How Much Electricity Do We Really Need?

Just how much energy do we really need? Are we wasting precious resources because old habits die hard? This winter's ice storm in Eastern Canada has underlined how reliant we have become on modern technology and the energy grid. A comprehensive study by the Swedish Council for Building Research shows that there is a great potential to reduce in a cost-effective manner electrical consumption in buildings.

Sweden's energy conservation activity is being driven by a decision made several years ago to close down the country's nuclear reactors (which provide 50% of the country's energy). The first of the reactors will be shut down this coming July. Sweden's national energy policy is changing to a greater reliance on sustainable energy. The change has significant consequences for homes and industry, as it is estimated that 560,000 single-family houses rely on electric heating.

How does one reduce reliance on electricity? Many economically viable measures have been identified. These include:

- replacement of: refrigerators, freezers, washing machines, lighting, appliances, fans and computers with new electricity efficient appliances when their useful life ends and replacements must be done in any case.
- changes and improvements in laundry rooms, building ventilation and lighting in multi family buildings
- window upgrades
- replacement of electric boilers at the end of their useful life with higher efficiency units.

Other energy savings in heating can be gained by making sure energy efficient upgrades are done when changes and other renovations are being done (e.g., adding insulation when the siding has to be repaired), or as specific measures (e.g., attic insulation upgrades). Use of district heating sys-

(Continued on page 18)

Pollutant Source Strength in New Houses

Comparing Conventional and R-2000 Houses

Indoor air quality is affected by emissions from the many activities, materials and products used in a house, and by the house's overall ventilation. Emissions from materials depend on many variables such as the type of material, environmental conditions (temperature and humidity), exposed surface area, air exchange rates, age of the material and material contamination. However, our understanding of the relationships between materials emissions and their impact on the overall indoor air quality in houses is limited.

The R-2000 Program identified the need to reduce the pollutant loading built into houses when the technical requirements were revised in 1993 by the introduction of a "pick-list" of options that target pollution sources. However, will reducing pollution loading during the construction of a house really have an impact? There has been much anecdotal commentary to suggest so, but measurements have been more difficult to come by.

A recently completed study for Canada Mortgage and Housing Corporation and Natural Resources Canada evaluated the effect of pollutant source strength on indoor air quality. Materials' emissions tests and indoor air quality measurements were done, and occupant activities and house operations were investigated. Volatile organic compounds (VOC) and formaldehyde were the contaminants looked at.

Six houses were monitored: just before occupancy, one month after occupancy and six months after occupancy. Five houses were conventional and one was an R-2000 house. One of the two R-2000 houses was described as an "Envirodesic"/R-2000 air quality design house with various low emitting materials. However, because of the homeowners' inappropriate intervention in the design and construction of this house, "Envirodesic" and R-2000 air quality criteria were not met.

Four of the houses were occupied by families with both children and adults, two by adults only. None of the occupants smoked, but at one house regular visitors smoked about one pack a week in the house. Four of the six occupants purchased new furniture at move-in or within the six-month study period. Cleaning products were generally used once or twice a week, and in three houses the occupants had hobbies that may introduce volatile organics.

Five of the houses were 2-storey with a basement and one was one storey with a basement. Only one house had a partially finished basement. Airtightness measurements ranged from 1.1 to 3.1 ACH at 50 Pa.

Five houses had ventilation systems that operated to existing code ventilation requirements. The average air change over a 7-day monitoring period ranged from 0.12 to 0.77 ACH. The low airchange rates were for a house that had a defective HRV during the test and represented only natural infiltration rates. The high rates were for houses that operated HRVs at high speed.

VOC sources include the materials and contents in the house, and also occupants and their activities. Control strategies are most effective when the significant sources are identified and reduced. Because of the wide range of products in a house, the study focused on those judged as having the most impact. The list included: carpet, vinyl resilient flooring, bathroom and kitchen cabinet frames, hardwood flooring, oriented strand board (OSB), plywood, wallboard and wood trim finished with oil paint, and counter tops. Builders were asked to select four products inside the building envelope with the biggest impact, based on installed square footage.

The residents were asked to answer a questionnaire after they moved in and after the 6-month testing period. The questions were structured to gather information on occupancy, ventilation systems, humidity sources, new furniture, and the generation of VOCs from sources such as cleaning products, personal care products and hobbies.

Overall, emissions decreased during the six months after construction. Before occupancy, the identified products were contributing close to 100% of the measured VOC levels. Six months after occupancy, the identified sources were only contributing about 20% of the indoor VOC levels, but the occupant related sources were dominant. VOC levels increased from pre-occupancy to initial occupancy at one month, but then decreased to less than the pre-occupied levels after six months. However, all VOC levels were greater than anticipated, being more than 1.0 mg/m³. This suggests that conventional ventilation rates cannot be expected to reduce VOC levels in new housing to levels less than 1.0 mg/m³.

Material VOC source strengths at preoccupancy ranged from 185 to 14,460 mg/h. The highest value was for a house that had oil paint trim and hardwood floors finished on site during the pre-occupancy monitoring session. The lowest pre-occupancy value of 185 mg/h was for the R-2000 house.

The apparent VOC source strengths (which take into account the effect of other materials that absorb and re-emit contaminants) for the houses increased from 1590 mg/h during pre-occupancy to 1960 mg/h during the first occupied session, and then decreased to less than half the pre-occupied values, 760 mg/h at six months.

Houses with higher air change rates had lower carbon dioxide levels but not necessarily lower VOC levels. VOC emission rates were the main factor in determining indoor VOC levels, not the ventilation rates. Accordingly, reducing VOC source emissions is more effective than to increase ventilation rates.

Measurements showed that the building materials were the main sources of formaldehyde. Indoor formaldehyde levels decreased to levels below Health Canada's 0.06 mg/m³ guideline. However, carpet and latex painted trim were identified formaldehyde sinks that became low level sources.

Materials such as carpeting and drywall, which had moderate or low emissions but large surface areas, were the dominant VOC sources. Reducing surface areas will reduce the initial source strengths and will also reduce the potential impact of sources acting as sinks that then could become sources later.

The carpet samples had VOC emission levels that exceeded the Canadian Carpet Institute criteria (0.5 mg/m².h) for low emitting carpet at pre-occupancy and one month after occupancy. At six months, two of the samples had very low VOC emissions while the other two had emissions that exceeded CCI criteria. The carpet emissions did not decrease as quickly as new carpet samples that were not exposed to other VOC sources. Carpet is a strong sink and re-emitter which would explain the gradual decrease in VOC emissions and increase in formaldehyde emissions.

VOC emission factors for the cabinet frames varied from house to house. Cabinet board with moderate or low emission factors can also have large surface areas, and can be a significant emission source, especially if a kitchen is large and there are more than the normal number of cabinets in a house.

Materials such as oil-based paint and carpeting which do not meet established low emission criteria should not be used. Unfortunately many materials do not have established low emission criteria. Emission labelling programs should be encouraged or manufacturers should independently develop and provide low emission materials.

VOC emissions from oriented stand board decreased six months after occupancy.

Formaldehyde emissions for painted trim varied considerably from house to house and with time. The oil based painted trim had the highest VOC emissions and decreased with time. For the latex-based paints, the formaldehyde emissions appear to increase with time. A recently published paper reported that a latex painted surface can generate formaldehyde in the presence of typical indoor levels of ozone.

Three houses had vinyl flooring. The VOC emissions decreased over six months.

Hardwood flooring samples varied considerably in their emissions. The pre-finished flooring had low VOC emissions but the flooring that was finished after it was installed in the house had very high VOC emissions at pre-occupancy and the first occupied session. After six months the VOC emission factor had decreased but was still significant.

Material VOC source control strategies are only effective in reducing VOC levels during the first months after occupancy. After six months the occupant related sources of VOCs are dominant. ☼

VOC emission rates were the main factor in determining indoor VOC levels, not the ventilation rates. . . . reducing VOC source emissions is more effective than increasing ventilation rates.

The study objectives were:

- To evaluate the quality of the indoor air in R-2000 houses and conventional houses before and after occupancy.
- To find out the extent to which the selection and use of healthy house ideas can improve indoor air quality.
- To examine the relationships between construction material emissions, occupant related emissions, ventilation system performance and indoor air quality.

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000

Evaluation of Pollutant Source Strengths and Control Strategies in Conventional and R-2000 Houses for Canada Mortgage and Housing Corp., Technical Policy & Research Division, Ottawa, ON
ORTECH Corp.

Technical Research Committee News

Canadian Home Builders' Association

Dynamic Performance of Floors

Forintek and the Canadian Wood Council have been doing extensive research for a long time on the performance of residential floors. This has led to revised span tables that appeared in the 1990 edition of the National Building Code. The tables now take into account floor deflection and vibration.

A 5-year project currently underway is trying to develop performance criteria that would directly deal with dynamic floor performance under occupancy loads. The work is presently directed at single and multi family construction.

The project team is looking for examples of bad floors (i.e., those with a big bounce). The work involves administering a questionnaire with the occupants, inspecting the structure, and performing static and dynamic tests to evaluate the floor's performance. Most of the tests done to date have been on relatively good floors. (No one wants to admit to problems?).

Now, the team is looking for more bad examples. If anyone has had problems with bouncy floors, or if you know of someone who does, contact TRC so that they can put you in touch with Forintek people to do an on-site investigation.

IRC celebrates 50th anniversary

Mention history, and except for history buffs, eyes glaze over and a big yawn settles in. However, knowing what has happened in the past can not only be interesting - it can be very valuable. Many problems arise because a fundamental principle has been forgotten, so past errors are repeated.

1997 marked the 50th anniversary of the Institute for Research in Construction. In that time, the IRC has contributed much to our understanding of the way buildings work, by conducting basic building science research, and doing product testing and developing Canada's National Building Codes. (Did you know that before the NRC developed the National Building Code, each municipality in Canada had its own building regulations which were largely developed by trial and error, and not necessarily based on scientific facts?)

It is the research work at the IRC that has put Canada at the forefront of building science research and construction knowledge, on a world wide basis.

As part of its anniversary celebrations, the IRC has published a 16-page booklet describing the history of the institute. The booklet is well worth taking a look at. It provides an interesting insight into a vital public institution that has had a major impact on this country, and especially on our industry.

The booklet is included in the fall 1997 issue of Construction Innovation newsletter. To get a copy phone 613-993-2607; Fax 613-952-7673

Code Review Task Force

A task force to review the building, plumbing and fire code development process has been formed by the Canadian Commission on Building and Fire Codes (CCBFC) and the Provincial/Territorial Committee on Building Standards (PTCBS). The intent is to establish a coordinated code development and review process. Recommendations of the task force may result in fundamental changes to the code development process in Canada.

Canadian building safety regulations are the responsibility of the provinces and territories. Since 1941, CCBFC (and its predecessors) has produced model building and fire codes. The uniformity of building and fire code requirements has benefited industry. Some jurisdictions, however, have established their own comprehensive provincial and municipal code review processes to consult with their stakeholders and to deal with regional issues.

The CCBFC recognizes that much can be done to improve the model-code development process to reflect the needs of authorities and code users better, and to eliminate the need for overlapping processes, thus reducing the burden these processes can impose on stakeholders.

The types of questions that will be addressed by the Task Group include:

1.How can a uniform code technical development and review process be best achieved? Will there have to be higher profile for provincial/territorial authorities as active participants in the code development process, recognizing they have the jurisdiction over building regulations?

2.Considering geographical and economic realities, how could greater participation in a coordinated national/provincial/territorial code development and review process be achieved? Would this mean more code development originating at the provincial/territorial level?

3.How should the process deal with the possibility of contradictory policy and technical advice from stakeholder groups?

4. What are the characteristics of model building, plumbing and fire codes that need to be accounted for in a code development process? Are the codes to be based on technical correctness only, cost impacts, or minimum requirements that would be supplemented to deal with local issues?

The work of the task force is to be completed by September 1998 so that the results can beincluded in the public review process for the 2001 Codes. Meetings have been held in Toronto, Winnipeg and Montreal. Meetings (all open to the public) are scheduled for:

Vancouver, March 29 & 30, 1998
Halifax, May 24 & 25, 1998
Edmonton, September 13 & 14, 1998

The Task Group welcomes comments, suggestions on additional issues to be discussed, and any recommended solutions from interested parties.

Information is available from the Canadian Codes Centre, Institute for Research in Construction, National Research Council of Canada, Montreal Road, Ottawa, ON K1A 0R6.

(Tel.: 613-993-9960).

Task Group agendas, proceedings, papers, membership and schedule are also available on the Internet at:

http://www.ccbfc.org/ccbfc/home_E.shtml
http://www.ccbfc.org/ccbfc/tgs/review/index_E.shtml
http://www.nrc.ca/ccbfc/tgs/review/index_E.shtml

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

Canadian Home Builders' Association, Suite 500, 150 Laurier Ave. West, Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060
Fax: (613) 232-8214
e-mail: chba@chba.ca
http://www.chba.ca

Letters to the Editor

Re: Energy Answers, (Solplan Review November 1977)

I read Rob Dumont's column on combo systems with great interest. A few years ago I tangled with some B.C. plumbing inspection authorities who were trying to have these systems banned in B.C. as a health hazard. I too have had a combo system in my own home, heating a bathroom and two bedroom dormers added to my house in the early 70's.

My system is hot-water baseboards served by a second water heater installed in the basement that also serves the domestic hot water needs of the upstairs bathroom. I am still on my second water heater on the combo system, having had about 13 years of service from the first one. This is noteworthy, considering the aggressive nature of Vancouver's very soft water. Both are conventional, naturally aspirated gas water heaters. The biggest mistake I made was using Type M (thin wall) copper tubing for the heating loop. I have had to replace some sections as it developed leaks. My biggest worry is that both my water heaters will fail on the same long weekend.

As for the health hazard issue, I wonder if any of your readers with combo systems, or who know people with them, have any evidence, or even suspicions, that the occupants of the home are suffering from more respiratory ailments than those in homes with separate heating systems and domestic water heaters?

It must be acknowledged that radiant floor tubing contains much more water than the piping to a fan-coil unit like Rob Dumont is using. Is there any evidence that there is such a proliferation of harmful bacteria in in-floor heating pipe during the off-season as to make people sick? (Or, as one plumbing inspector claimed, kill them?)

George Pinch, Energy Management Engineer, BC Hydro, Vancouver BC

Re: Energy Answers, (Solplan Review November 1977)

We have designed many combo systems, so I was very pleased to see Rob's article, but feel some clarifications and additions would be of benefit.

1. Forced Air vs. Hydronic Delivery

The article only focuses on air distribution systems. We are increasingly distributing heat using hydronic convectors or coils in the air stream of the heat recovery ventilator. There is net energy saving of about 250 w to 450 w (650 kWh to 4500 kWh per year) using pumps compared with fans.

We typically use convectors in joist spaces between floors of conditioned space. In new construction we use open web floor joists to allow for free flow of convected air, so the floor cavity acts as a large radiant surface upwards and downwards. This kind of system has been successfully used in a 20-house subdivision near Fort Frances east of Winnipeg for the last 4 years.

2. Water Heater Availability

I think the situation of water heater availability is not as bleak as Rob suggests. Gas companies are interested in combo systems for low space heating loads such energy efficient homes and townhouses. In Ontario one can lease mid-efficiency storage gas water heaters with outputs of 8 kW to 12 kW from the gas utilities (Consumers Gas, Union Gas and Centra Gas).

One US-based supplier is State Industries. Ecologix Heating Technologies (an Ontario company), is marketing, in limited quantities, the Delta Temp unit that was one of the promising technologies identified by the Advanced Houses Programs. Slantfin, a major convector manufacturer, has a small hydronic water heater similar to the Delta Temp. These types of units are available for less than $1500. The real void exists in high-efficiency low-output water heaters.

3. Sizing of Water heater

While equipment should always be sized correctly, a storage water heater (or water heater connected to a storage tank) is buffered from the space heating load. The benefit of storage is that the water heater is controlled by the tank aquastat and responds to a minimum load governed by how much water is to be heated. This ensures a minimum runtime. If storage is reduced and water heater output is maximized, we have a boiler or instantaneous water heater for which system design is different.

4. Fan operation

I don't fully agree about the increased runtime of fans with lower temperature systems. A system designed for a given design heating load will run continuously only on the coldest days and cycle on moderate days. However, as you state, to deliver the peak heat demanded may require higher airflows with lower supply temperatures. As low temperature "combo" supply can be achieved without any fanpower I am unclear why a combo system would need much more runtime unless the hydronic coil is undersized. Is there research on this?

I also note that the issue of continuous fan runtime for ventilation was not mentioned.

I appreciate the opportunity afforded by Rob's article to reinforce the move to simpler, more affordable and higher efficiency heating systems.

Mario Kani,
Allen Kani Associates,
Toronto, ON

Re: How Much per Square Foot? (Solplan Review November 1977)

Thank you for elaborating on the vehicle cost metaphor. I have been using it for years with clients (without much luck!) I could even go a step further: In Vancouver today a builder could not sell a condo unit with a 25-year envelope warranty. Underwriting the extra quality in one area would mean leaving out the granite and stainless steel. Let's face it. Today's buyer is looking at the fins, not the car.

Despite our ever increasing technical capabilities, housing today is where cars were in the 1950's!

D. Riley
White Rock, BC

Re: Too-Tight Homes (Solplan Review, September 1997)

Thanks for an excellent article on this subject. The points made were very good ones. I have a somewhat different line, but may have to change it in light of what you said in the second-last paragraph of the article, namely "Every house in North America is too tight."

However, my version would say:

Both people and houses need continuous ventilation to stay healthy, but natural ventilation does not provide continuous ventilation. Therefore, we need good mechanical ventilation. Good ventilation means balanced ventilation, and balanced works best in tight houses. Therefore, we need tight houses with good balanced ventilation systems in them. Anything less is just not good enough.

My arguments are almost identical to yours. Hopefully we will be heard soon!

By the way, it was the leaky houses in our Wallaceburg study that had the most mold and the sickest kids. Going back to leaky houses is not the way (especially since we don't know how to build houses to be really leaky and not have people seal them up to avoid the discomfort of the resulting drafts).

Again, well done!

Jim H White
Senior Researcher, CMHC
Ottawa, ON

Re: The true cost of candle power (Solplan Review November 1977)

Thanks for the entertaining article about the cost of candles. The delightful absurdity of the final comparison has prompted another thought. People persist in choosing this inefficient light source for times of special human importance: romantic dinners, festive holidays, birthdays etc. Clearly, as an ambient light source candles fit the bill, and at 1060 lumens to 12.5, the old 60 watt bulb looks like overkill.

It may seem like a strange windmill to tilt at, but for someone figuring out what they really need (say, to size a photovoltaic electrical supply for a new house), some pointed questions about the origin of our design standards may be helpful. Not so long ago lighting design standards were written by GE, and basically said, more is better. Recently, more intelligent heads involved with the IES have started to question the measurement of light in terms of brightness and power density, and looked at other issues like contrast, glare and tasks.

Not surprisingly, looking at the performance of lighting rather than raw power suggests we can work better with less. Maybe the candles aren't so inappropriate after all.

Keep up the great work.

Stephen Pope, Architect
Ottawa, ON

Renovation/Addition, North York, Ontario

Home based work is more common today, and is having an impact on house design. It is relatively easy to adapt new home designs to accommodate suitable work spaces. A bigger challenge is adapting existing housing. However, it is something we must seriously consider simply because there is so much existing building stock.

A renovation/addition in North York tackled these issues, and received an award from NESEA (the North East Solar Energy Association) in the process.

The owners needed living space for five people plus space for a medical office. They wanted to incorporate a comprehensive environmentally friendly strategy that could serve as a showcase for others in their area. That is why the existing 1200 sq. ft. plus basement, post World War II house was to be retained rather than demolished and rebuilt from scratch. The addition added 2300 sq. ft. of new heated space for a total of 3500 sq. ft. of heated space (including a finished basement).

The approach taken by Allen Kani Associates in Toronto was to design the house as an integrated system; the thermal envelope, ventilation, water and space heating were designed to interact to produce the desired comfort and energy performance. The project shows that, with careful attention to design, existing conventional housing can be renovated and greatly improved in terms of comfort, indoor air quality, energy efficiency and environmental friendliness.

Because of these high insulation levels and airtight construction, the total design heat load was reduced to 7500 watts (25,500 BTU). The

Energy Efficient Building Features

Below Grade Walls are pressure treated 2x8's filled with mineral wool batt insulation and sheathed with Rigid Rockwool for a total R-Value of 40.

Above Grade Walls are double studs with mineral wool batt insulation and sheathed with Rigid Rockwool for a total R-Value of 40.

Windows are triple glazed, 2 coats low e, 2-½" argon filled spaces, insulated fiberglass frames, and silicon foam insulating spacers. The centre of glass R-value is 7.

Cathedral and flat ceilings have mineral wool batt insulation for a total R-value of 60. The flat roof surfaces are sod covered to provide added protection due to the thermal mass that reduces the temperatures acting on the house.

Airtightness The entire house is air sealed. The air tightness is 0.75 ACH @ 50 Pa for the addition, and 1.5 ACH for renovated portions of existing building.

design temperature for Toronto is -17°C. Such a low design load means that the space heating system can be significantly reduced.

Space heating is provided by a hybrid combination system using a masonry heater with a gas water heater as a back-up. Solar panels preheat water for the domestic hot water. Based on '96 and '97 energy bills, the combined space and water heating consumption for the year is about 27,500 kWhr plus $300 in wood.

Unlike conventional fireplaces, the contra-flow masonry wood heater burns wood quickly, cleanly and efficiently (70%). Heat is stored in the brick mass and radiated slowly to the space, providing a direct radiant source. A water heating coil in the firebox feeds hydronic coils in the ventilation air supply, which is provided via a heat recovery ventilator. This warmed supply air is heated by the water coils and distributed through the first floor ceiling joist space cavity that effectively provides an additional radiant heating effect for the floor above and the ceiling surface below.

Space Cooling

Toronto has a significant summer cooling load. Cooling is produced passively by the night sky radiation effect that is used to cool water on the roof. Water is allowed to trickle across the roof at night so that its heat content is radiated into space. The cooled water is recaptured at the eave and used as a cooling medium. Cooled water is stored in a two-tank cistern in the basement and pumped to coils in the ventilation air stream.

Passive cooling by stack effect is also available through the use of opening skylights over the three storey stairway shaft.

Rainwater is collected from the sod-covered flat roof surfaces. The sod and soil substrate provides a first-stage filtration. The water is stored in a cistern for use in the clothes washer. A separate water supply was installed in parallel to the city water supply in the laundry. Water source is selected manually.

Cost per square foot was $105 while standard construction for a similar project was estimated to be $100 per sq. ft.

Resource Efficient Features

Some benefits to both the homeowner and society for this design compared to conventional design approaches include:

- ☞ substantial reduction in fossil fuel consumption
- ☞ zero ozone depleting substances used in the construction
- ☞ use of rainwater for laundry and as space cooling medium
- ☞ a substantial portion of the existing building was retained
- ☞ removed elements of the building were sent to a recycled building material facility. ☼

Design Alternatives

Information:
Domespace Homes Canada Ltd
RR#1 Site 16 C45
Gabriola, B.C. V0R 1X0
Tel: (250) 247 9962
e-mail: dome@island.net

Have aliens landed on Gabriola Island (where this structure is found)? Is it a set from the X-Files? A throwback to the '70s hippie hideouts? Actually, it is an example of a use of materials in an innovative manner to create a unique structure. The idea is simple: based on a dome (not the geodesic structural system) that uses curved glue-laminated beams for its structure.

The entire building is built on a small central foundation, where the services enter the house. The small foundation footprint makes it especially interesting for difficult-to-build-on sites. The building can be rotated so that living areas can be moved to capture the sun or changing views during the day (all it takes is three people pushing the structure to set it in motion, and rotate it).

The dome shape interiors are very organic. With good insulation levels the dome is also energy efficient, and can be heated by a centrally located wood heater (the core of the building does not rotate).

Creators of the design concept are Breton boat builders. Applying boat building principles, the finishing and detailing are not as formidable as may appear at first. Several structures using the system (both residential and commercial applications) have been built in various parts of Europe. This is the first example that is being built on Gabriola Island in BC. While it is not the sort of design suited to a standard city lot, there are many rural and semi-rural properties where the unique features may justify considering this type of design. ☼

Energy Answers

Rob Dumont

Are carbon monoxide (CO) detectors a good idea? I have heard reports that these detectors have "hair triggers," and that they generate many nuisance alarms.

CO detectors are better than a good idea. They are a great idea. I am a very strong believer in carbon monoxide detectors. No ifs, ands, buts, or maybes.

Carbon monoxide is a killer. At low levels CO can cause headache, dizziness, nausea, blurred vision, chest pain and fainting. These symptoms are often mistaken for ailments like the flu. Continued high exposure can bring on unconsciousness, brain damage and death.

I think that everybody who has any combustion device in their house should buy a CO detector immediately. Seventy-five bucks to save a life is small potatoes. I am also starting to come around to the idea that every dwelling, whether it has combustion devices or not, should have a CO detector.

Here are a few incidents that have led me to this conclusion:

Incident number 1. The January '98 ice storm in Eastern Ontario and Western Quebec saw several hundred people poisoned by CO when they used camp stoves and barbeques to try to keep their houses warm after the electricity went out. As of January 17, at least six people in Quebec had died of CO poisoning.

Incident number 2. Recently in Iowa an outdoor barbecue with smoldering charcoal briquets was placed under a camper trailer. The carbon monoxide released from the briquets infiltrated the trailer and killed two people.

Incident number 3. An elderly uncle of mine living in B.C. almost killed himself recently by CO poisoning. He left his car running in an attached garage with the garage door down, and entered his house. (All cars emit some CO, but a car in a closed garage will emit much higher levels of CO as the oxygen is depleted). The CO leaked into the house. Fortunately the son came by before the CO had overcome his father. "Another few minutes and I am certain he would have died, as he had a severe headache," noted his son.

Incident number 4. Again in January 98, an apartment building in Lethbridge, Alberta was contaminated with CO, sending 37 people to the hospital.

All these incidents were "unusual," but they all point to the dangers of carbon monoxide, and the desirability of having a working carbon monoxide detector. Ideally a house would have both a battery powered unit and an AC plug-in unit.

What most people do not realize is that carbon monoxide is regularly produced by many common devices. Natural gas ovens, even when new and properly installed, are producers of CO. Carbon monoxide levels of approximately 100 parts per million (ppm) have been found in the kitchens of some houses immediately after gas stoves were used for cooking, according to information in the **Exposure Guidelines for Residential Indoor Air Quality** produced by Health Canada. Placing a cold pot of water on a gas stove will produce CO, as the cold pot results in a lowered flame temperature and incomplete combustion. Similarly, many natural draft gas water heaters will produce CO when the tank is full of cold water. If the water heater chimney has a poor draft, the CO will enter the house.

Much greater sources of CO are blocked or collapsed chimneys, and cracked furnace heat exchangers, particularly if the cracked heat exchanger causes the burner gas flow to be disturbed.

What is a safe level of CO in a house?

The Canadian guideline is 11 ppm over an eight hour period. The ASHRAE Standard 62-89 is roughly similar at 9 ppm over an eight hour period. For short term exposures, the Canadian guideline is 25 ppm (one hour exposure.)

Levels of CO above about 5 ppm suggest the undesirable presence of combustion pollutants. Outdoor levels of CO in rural areas are usually less than 1 ppm.

Existing CO detectors have an "ignore point" of 15 ppm over a 30 day period. A new standard developed by Underwriters Laboratory (UL) has raised the ignore point to 30 ppm over a 30 day period. This new standard is under review and due to be issued in 1998, according to an article in the December 97 issue of the Journal of Light Construction.

These newer CO detectors that will only trigger at 30 ppm (when the health people suggest that 11ppm is the guideline) are not a very good idea, in my opinion.

This new standard seems to be quite lax. What can a person do to get a more sensitive CO detector?

Fortunately, many CO detectors have a digital readout on them. Consumer Reports gave the highest rating to the Nighthawk Models 900-0046, 900-0014, 900-0056, and 900-0057, all with digital displays. With the digital readout devices, you can tell if there is any CO in your house, and be proactive about reducing the CO source.

You strongly believe in CO detectors. What are other groups saying about them?

I will leave the last word to Consumer Reports. In their 1998 Buying Guide they say the following: "CO detectors should be in any home with a fuel-fired furnace, appliance or space heater, a wood burning stove or fireplace, or an attached garage--all common sources of carbon monoxide."☼

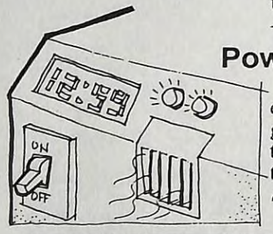
(Continued from page 9)

tems, especially in denser communities and for multi family developments, can also significantly improve system efficiency.

The Swedes estimate that electricity consumption for households, building management and non-residential premises (but not electric heating) could decrease 38% by 2020 if everything that is cost effective is carried out. According to the analysis, much of this reduction is due to a shift from electricity to other fuels in dual purpose boilers.

The challenge is to distribute information to make sure that all professionals and individuals know that reduction of electricity use is possible and cost effective. It is also important to make sure that decision makers know the correct technical solutions available and that they accept them when a decision is made.

Sweden is far away and has limited alternatives to nuclear energy. However, there are lessons for us in Canada. Last year's closure of much of Ontario Hydro's nuclear capacity and this winter's storm shows we are also vulnerable. The impact in Ontario may not be immediately visible, as alternative power sources can be found from other suppliers in North America and by firing up thermal generators (at the expense of much greater CO2 emissions). However, if we are concerned about the long term, the reliability and source of power supply is a concern. As builders and designers, we should keep this in mind. It could even be a sales feature for those energy efficiency upgrades.☼



Power Consumption in the Off Position

All the lights and appliances are shut off, yet the electric meter is merrily spinning along. What is going on? All those electronic appliances with timers or remote control functions use much electricity even when they are supposedly turned off. Although the electricity used by each appliance is small, the combined total becomes large because there are many appliances with timers or remote control functions. If an appliance is plugged in, it is in a standby mode and uses electricity.

A survey by the Jukankyo Research Institute in Tokyo, Japan has found that electricity used in the stand-by mode accounts for about 15% of total electricity used by a Japanese household.

One Tokyo household (a married couple without children), had 18 electronic appliances (including TV, microwave oven, air conditioner and washing machine) that were drawing 82 watts of electricity when "off". This amounts to 720 kWhr, accounting for 17% of annual electricity consumption for the household. In three other houses surveyed, the electricity draw ranged from 61 to 74 watts. At $0.06/kWhr this is about $43.00 per year.

The numbers for Canadian households may vary, but we use many of the same appliances. There are about 10 million households in Canada. Effectively, it means a power plant is generating electricity just to feed household appliances in the "off" position.☼

What Today's Best Built Homes Are Wearing

DOW STYROFOAM CLADMATE Insulated Sheathing

- Prevents heat loss through framing
- Reduces air infiltration
- Cost effective wall insulation
- Easy to work with

For more information visit your local lumberyard or call 1-800-898-WARM (9276)

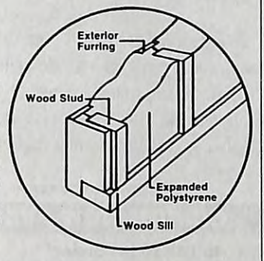
*Trademark licensed from The Dow Chemical Company

Dave McLung
Construction Materials, Canada, Western Zone
Dow Chemical Canada Inc.
150 - 1657 - 128 St.
Surrey, B.C. V4A 3V2
Tel: (604) 538-5241
Fax: (604) 538-4924

Insul-wall BUILDING SYSTEM

Toll Free Canada-Wide 1-800-565-1291

For superior quality wall construction



INSUL-WALL is available as a preassembled wall structure, or pre-cut component package for on-site assembly. This unique panel system incorporates the use of high quality environmentally pure, EPS rigid insulation with conventional wood framing.

- Superior insulation
- Eliminates thermal bridging problems
- Structural stability
- Manufactured to your specs
- Faster on site construction
- Eliminates air movement and moisture build-up in the wall cavity

For your residential, commercial and industrial projects, INSUL-WALL is your constructive solution.

FABRICATORS ACROSS CANADA
CCMC evaluation Report No. 09589

Newfoundland
Reardon Construction and Development
P.O. Box 2069
St. John's, NF A1C 5R6
Tel: (709) 579-1010
Fax: (709) 579-4660

Maritime Provinces
Truefoam Limited
11 Mosher Dr.
Dartmouth, N.S.
B3B 1L8
Tel: (902) 468-5440
Fax: (902) 468-4691

The Urban Farmer
PO Box 3451 Stn B
Fredericton, N.B.
E3A 5H2
Tel: (506) 458-9666
Fax: (506) 451-1619

Quebec
Fransye Lte.lc.
671 Rue Leville
Terrebonne, Que.
J6W IZ9
1-800-363-2307
Tel: (514) 492-2392
Fax: (514) 492-5415

Ontario
Ottawa
Newhouse Building Systems
49 Stevenson Cr.
Renfrew, ON
K7V 1J4
Tel: 1-800 267-4424
613-432-4988

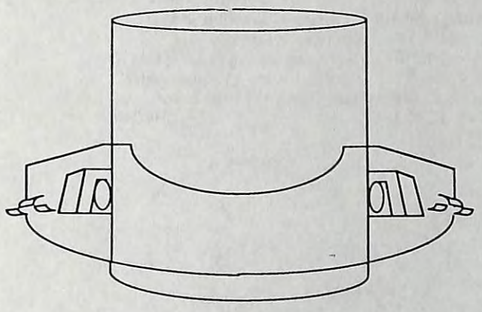
Kingston
Robert Preston Enterprises
R.R. #1
Enterprise, ON
K0K 1Z0
Tel: (613) 379-5532
Fax: (613) 379-5557

Sudbury
Insul-North Building Systems Ltd.
268 Cedar St.
Sudbury, ON
P3B 1M7
Tel: (705) 671-2697
Fax: (705) 675-6460

Manitoba, Saskatchewan Alberta, BC, NWT, YT
Beaver Plastics
12150 - 160th St.
Edmonton, AB
T5V 1H5
Tel: (403) 453-5961
Fax (403) 453-3955

ENEREADY

ENEREADY PRODUCTS LTD. Tel (604) 433-5697 Fax (604) 438-8906
6860 Antrim Avenue, Burnaby, British Columbia, CANADA V5J 4M4



Speedi™ Sleeve

4" Ventilation Grill Fitting

Coming Events

March 5-8, 1998
Energiesparmesse
Energy Efficiency Conference and trade fair
Wels, Austria
Information:
Tel: 43-732-6584-4380
Fax: 43-732-6584-4383
e-mail: *esv1@esv.or.at*

April 28-30, 1998
interBUILD
Calgary, AB. Housing and Construction show
Information:
Tel: 888-922-3600
Fax: 888-922-3606
e-mail: *reg@interbuild98.com*
http://www.interbuild98.com

May 4-6, 1998
Renewable Energy Technologies in Cold Climates
International conference, incorporating 24th annual conference of the Solar Energy Society of Canada
Montreal, Que
Information:
Tel: 613-234-7004
Fax. 613-234-2988

August 22-23, 1998
EarthFEST
Courtenay, BC
A fun event to bring people together and provide them with enthusiasm, ideas and tools to live more sustainably on the planet. Themes & technologies & methods to be demonstrated
F = Food E = Energy S = Shelter T =Transportation
+ Water
Information:
Tel: 250- 537-2616
Fax: 250- 537-2681
e-mail: *earthfest@saltspring.com*

Solplan Review Back Issues

A limited number of back issues are available, at a special price of $4.50 each (plus 7% GST).

Bundle special: a random selection of back issues (minimum 22 copies) are available for only $50.00 (plus 7% GST).

Solplan Review
Box 86627,
North Vancouver, B.C. V7L 4L2
e-mail: solplan@direct.ca

CD-ROM NOW AVAILABLE

WE WROTE THE BOOK

On Quality Construction and Energy Efficiency

Canadian conditions make unusual demands on a builder. To withstand the world wide temperature fluctuations, rain, snow and sun of our country, Canadian homes have to be better built.

It's no wonder, then, that the Builders' Manual of the Canadian Home Builders' Association* is widely regarded as the bible of the residential construction industry. The techniques pioneered in the R-2000® program are now authoritative guidelines for building superior, energy-efficient housing anywhere in North America.

The newest edition offers 330 pages of concise information and easy-to-follow illustrations. It's clearly written so you can use it as a guidebook or adapt innovative techniques to your own methods.

® R-2000 is a registered trademark.
* The CHBA is a voluntary private-sector organization which represents the residential construction industry in Canada.

Canadian Home Builders' Association

Subjects include:

■ Aspects of building science ■ Design consideration ■ Air, weather and moisture barriers and vapour diffusion retarders ■ Materials ■ Foundations ■ Floors ■ Walls ■ Attics and roofs ■ Windows and doors ■ Domestic hot water systems ■ Principles of space conditioning ■ Heating systems ■ Ventilation systems ■ Other space conditioning equipment

http://www.buildermanual.com

CD-ROM NOW AVAILABLE

Yes , I want to place an order!

Send me _____ CHBA Builders' Manual(s). Canadian Prices: Builders' Manual only $55.00 + $3.85 (GST). CD ROM only $55.00 + $3.85 (GST) - Bonus package CD-ROM and Builders' Manual $70.00 + $4.90 (GST). Mailing costs included. GST Reg. # R106847130 [Add HST where applicable]

❑ VISA ❑ M/C Card #_____ Expiry date _____

Enclosed is a cheque/money order in the amount of $ _____

Name _____

Company _____

Address _____

City _____ Province _____

Postal Code _____ Phone (_____) _____

Make cheque or money order payable to CHBA and mail to: Builders' Manual Sales
Canadian Home Builders' Association,
150 Laurier Ave. West, Suite 500, Ottawa, Ont. Canada K1P 5J4
CHBA FAX: 613-232-8214 e-mail: sales@chba.ca

SOLPLAN REVIEW is an independent Canadian Journal published 6 times per year to serve the needs of professionals and interested lay persons. It provides news, technical details, new product information, insights and commentary on developments covering all aspects of building science and energy efficient building practice for new and retrofit residential construction. Technical information is presented in a clear, concise manner, without resorting to jargon.

SOLPLAN REVIEW is an independent subscription supported publication, that relies on the support of readers. *If you are seeing this journal for the first time, and find it valuable, why not ensure you don't miss any copies. Subscribe today!*

YES, I WANT TO SUBSCRIBE TO **SOLPLAN REVIEW**

In Canada: 1 year: $40.66 ($38.00 + 2.66 GST) [NB, NS, NF $43.70 includes HST]
2 years: 77.04 ($72.00 + 5.04 GST) [NB, NS, NF $82.80 includes HST]
USA and other foreign: 1 year $46.00 per year 2 years: 88.00 (USA and other foreign in US funds)
Pay by: VISA MASTERCARD CHEQUE

Card No. _____ Exp. date: _____

Signature _____

NAME _____

ADDRESS _____

_____

POST CODE _____

the drawing-room graphics services ltd.
Box 86627 North Vancouver, B.C. V7L 4L2
FAX (604) 689-1841
e-mail: solplan@direct.ca